ANNALS OF THE NEW YORK ACADEMY OF SCIENCES

*Volume 469*
*May 22, 1986*

# BIOCHEMICAL ENGINEERING IV[a]

*Editors and Conference Organizers*
HENRY C. LIM and K. VENKATASUBRAMANIAN

CONTENTS

Preface. By HENRY C. LIM and K. VENKATASUBRAMANIAN ..... ix

**Part I. Recent Advances in Genetic Engineering**

Genetic Engineering of Extracellular Enzyme Systems of *Bacilli*. *By* D. J. MCCONNELL, B. A. CANTWELL, K. M. DEVINE, A. J. FORAGE, B. M. LAOIDE, C. O'KANE, J. F. OLLINGTON, and P. M. SHARP ..... 1

Characterization of the Expression of Conalbumin and Ovalbumin Sequences Cloned into the *Pst*I Site of pBR322. *By* F. GANNON, J. M. JELTSCH, J. BLOCH, A. KRUST, J. M. GARNIER, J. M. BORNERT, and P. GILNA ..... 18

Chemical Synthesis, Cloning, and Expression of Genes for Human Somatomedin C (Insulin-like Growth Factor I) and $^{59}$Val-Somatomedin C. *By* MINEO NIWA, SUSUMU SATO, YOSHIMASA SAITO, FUMIAKI UCHIYAMA, HIROKI ONO, MITSUO YAMASHITA, TADASHI KITAGUCHI, YUMIKO SHIGA, JOJI NOTANI, HISASHI YAMADA, YOSHINORI ISHII, IKUO UEDA, and YASUYUKI TAKAGI ..... 31

**Part II. Design, Operating Strategies, and Separation for Bioprocesses**

Using Fault Analysis Methods to Improve Bioreactor Safety. *By* RAYMOND P. JEFFERIS III and STEPHEN T. SCHLAGER ..... 53

New Separation System for Mammalian Cells with Large-Scale Centrifugation. *By* K. SHIMAZAKI, N. NISHIMURA, and H. SHIBAI ..... 63

Scale-up of Fermentation Processes Using Recombinant Microorganisms. *By* DEWEY D. Y. RYU and R. SIEGEL ..... 73

Design and Operating Strategies for Immobilized Living Cell Reactor Systems: Part I. Biosynthesis of Candicidin. *By* SUBHASH B. KARKARE, K. VENKATASUBRAMANIAN, and W. R. VIETH ..... 83

Design and Operating Strategies for Immobilized Living Cell Reactor Systems: Part II. Production of Hormones by Recombinant Organisms. *By* SUBHASH B. KARKARE, DEBORAH H. BURKE, ROBERT C. DEAN, JR., JEFFREY LEMONTT, PETER SOUW, and K. VENKATASUBRAMANIAN ..... 91

Model for the Dynamics of Colicin Plasmids in Continuous Culture. *By* DOUGLAS A. LAUFFENBURGER ..... 97

[a]This volume is the result of the Fourth International Conference on Biochemical Engineering, held by the Engineering Foundation with the support of the New York Academy of Sciences and the National Science Foundation, on October 1–5, 1984, in Galway, Ireland.

The Automation of Bioprocesses. *By* PIERRE M. BONTE ..... 104

Stability of Continuous Culture with Recombinant Organisms. *By* D. DIBIASIO and C. SARDONINI ..... 111

## Part III. Mass Transfer and Transport in Bioreactors

A Microbial Culture as an Oxygen Sensor for Reactor Mixing Effects. *By* J. MOES, M. GRIOT, E. HEINZLE, I. J. DUNN, and J. R. BOURNE ..... 118

Membrane Separation Coupled with Electrophoresis. *By* J. HONG and C. K. LEE ..... 131

Measurement of Inert Gas Permeabilities in Compact Bacterial Cell Aggregates Using an Annular Reactor. *By* SHARI B. LIBICKI, PETER M. SALMON, and CHANNING R. ROBERTSON ..... 145

Membrane Reactors in Bioprocessing. *By* STEPHEN L. MATSON and JOHN A. QUINN ..... 152

Transport Mechanisms of Biological Colloids. *By* JOHN L. ANDERSON ..... 166

Measurement and Control of Dissolved Oxygen below 100 ppb. *By* E. HEINZLE, J. MOES, M. GRIOT, E. SANDMEIER, I. J. DUNN, and R. BUCHER ..... 178

Behavior of the Glucose Sensor at Depressed Oxygen Concentrations. *By* SHINICHIRO GONDO and MICHIO MORISHITA ..... 190

## Part IV. Biokinetics and Bioreactor Modeling

Studies of Host-Plasmid Interactions in Recombinant Microorganisms. *By* J. E. BAILEY, N. A. DA SILVA, S. W. PERETTI, J.-H. SEO, and F. SRIENC ..... 194

Active Inducer Transport and Regulation of Microbial Enzyme Biosynthesis in Chemostat Cultures. *By* N. G. RAY, W. R. VIETH, and K. VENKATASUBRAMANIAN ..... 212

A Structured Model for Immobilized Cell Kinetics. *By* H. G. MONBOUQUETTE and D. F. OLLIS ..... 230

Effects of Temperature on Plasmid Stability and Penicillinase Productivity of a Transformant of *Bacillus stearothermophilus*. *By* SHUICHI AIBA and JUN-ICHI KOIZUMI ..... 245

Application of EPR Methods in Studies of Immobilized Enzyme Systems. *By* GREGG A. MARG, GLENN L. MILLHAUSER, PAUL S. SKERKER, and DOUGLAS S. CLARK ..... 253

Kinetics of Secondary Metabolite Synthesis in Batch Culture When Two Different Substrates Limit Cell Growth and Metabolite Production: Xanthan Synthesis by *Xanthomonas campestris*. *By* ALICIAN V. QUINLAN 259

## Part V. Tissue Cultures

Bioreactors for Immobilized Plant Cell Cultures. *By* M. L. SHULER, G. A. HALLSBY, J. W. PYNE, JR., and T. CHO ..... 270

Some Engineering and Economic Aspects of Continuous Cultivation of Insect Cells for the Production of Baculoviruses. *By* J. TRAMPER and J. M. VLAK ..... 279

Immobilization of $\beta$-Galactosidase in Porous Supports. *By* JIRI E. PRENOSIL and HENRIK PEDERSEN ..... 289

## Part VI. Biological Production of Chemicals and Energy

Energy from Biomass: Saccharification of Beet Pulp Using Fungal Enzymes. *By* M. P. COUGHLAN, P. J. CONSIDINE, A. O'RORKE, A. P. MOLONEY, R. K. MEHRA, T. J. HACKETT, and J. PULS ..... 294

Upgrading the Value of Agricultural Residues. *By* P. J. CONSIDINE, R. K. MEHRA, T. J. HACKETT, A. O'RORKE, F. R. COMERFORD, and M. P. COUGHLAN ..... 304

Prolonged Photoevolution of Hydrogen by *Mastigocladus laminosus*, a Thermophilic Blue-Green Alga. *By* YOSHIHARU MIURA, SHOKO FUJIWARA, and KAZUHISA MIYAMOTO ..... 312

Anaerobic Fixed-Film Fermentation of Organic Effluents from the Food and Drinks Industry as a Means of Biological Energy Production. *By* L. K. DUNICAN, P. J. NEWELL, and K. J. MCKEOWN ..... 320

## Part VII. Estimation, Optimization, and Control of Bioreactors

Application of Macroscopic Balances and Bioenergetics of Growth to the On-Line Identification of Biological Reactors. *By* GREGORY STEPHANOPOULOS ..... 332

On-Line Chromatographic Analysis and Fermenter State Characterization of Butanol/Acetone Fermentations. *By* CHARLES L. MEYER, JOSEPH K. MCLAUGHLIN, and ELEFTHERIOS T. PAPOUTSAKIS ..... 350

Fed-Batch Culture with Automatic Feedback Control: An Advanced Operational Mode of Microbial Reaction. *By* TSUNEO YAMANÉ and SHOICHI SHIMIZU ..... 364

Optimal Glucose Feed Rates for Fed-Batch Penicillin Fermentation: An Efficient Algorithm and Computational Results. *By* YVES J. TAYEB and HENRY C. LIM ..... 382

Optimization of the Simultaneous Saccharification and Fermentation of an Insoluble Substrate into Microbial Metabolites. *By* J. A. ASENJO, J. L. SPENCER, and V. PHUVAN ..... 404

## Part VIII. Microbial Production of Fuels

Optimization of Selection Stress in a Chemostat. *By* C. WANDREY, A. AIVASIDIS, and KH. BASTIN ..... 421

Effect of Furfural and Ethanol on the Growth and Energetics of Yeast under Microaerobic Conditions. *By* R. L. FIREOVED and R. MUTHARASAN ..... 433

Index of Contributors ..... 447

The New York Academy of Sciences believes it has a responsibility to provide an open forum for discussion of scientific questions. The positions taken by the participants in the reported conferences are their own and not necessarily those of the Academy. The Academy has no intent to influence legislation by providing such forums.